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PUBLISHED SEPARATELY:

Flood Insurance Rate Map

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FLOOD INSURANCE STUDY
CITY OF WESTWORTH VILLAGE, TEXAS

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the City of Westworth Village, Tarrant County, Texas, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates and assist the community in their efforts to promote sound flood plain management. Minimum flood plain management requirements for participation in the National Flood Insurance Program are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the state (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were prepared by the U. S. Army Corps of Engineers (COE), Fort Worth District, for the Federal Emergency Management Agency (FEMA), under Inter-Agency Agreement No. EMW-E-0941, Project Order No. 12. This study was completed in November 1983.

1.3 Coordination

On May 12, 1982, an initial Consultation and Coordination Officer's (CCO) meeting, combined with a time and cost meeting, was attended by representatives of the City of Westworth Village, the COE (the study contractor), and FEMA. At this meeting, the city presented the COE with a community boundary map, and streams to be studied by detailed methods were identified.

On July 19, 1985, the results of the study were reviewed at the final CCO meeting attended by representatives of the city, FEMA, and the study contractor.

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2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the City of Westworth Village, Tarrant County, Texas. Carswell Air Force Base is not included in this study. The area of study is shown on the Vicinity Map (Figure 1).

The West Fork Trinity River, Farmers Branch, and Kings Branch were studied by detailed methods for their entire stream lengths within the community. The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction through November 1988.

Sump areas in Westworth Village were studied by approximate methods. Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to, and agreed upon by, FEMA and the City of Westworth Village.

2.2 Community Description

The City of Westworth Village is located in north central Texas in the northwest portion of Tarrant County. It is situated approximately 7 miles west of downtown Fort Worth. Westworth Village is bordered by the City of White Settlement to the west and the City of Fort Worth to the north, south, and east. The land area contained within the corporate limits is approximately 2 square miles. According to U. S. Census Bureau figures, the population in 1980 was 3,651 (References 1 and 2).

Approximately 1.3 miles of the West Fork Trinity River flows along the east boundary of the city. The river has a drainage area of approximately 2,615 square miles at the Fort Worth gage which is approximately 6 miles downstream from the corporate limits.

Farmers Branch, which is approximately 2.4 miles long within the corporate limits, flows from west to east into the West Fork Trinity River in the northern part of the city. Farmers Branch has a drainage area of approximately 11.4 square miles.

Kings Branch, with a drainage area of approximately 4.5 square miles, flows from south to north into Farmers Branch near the northeast part of the city. Approximately 1.2 miles of this stream affect the city.

The climatological data at Fort Worth are considered indicative of the conditions prevailing in the region. Average rainfall is 32.30 inches

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FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF WESTWORTH VILLAGE, TX

(TARRANT CO.)

APPROXIMATE SCALE

2000 0 2000 4000 6000 FEET

VICINITY MAP

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for the last 10-year period. The maximum and minimum annual rainfall occurring during the last 57 years was 51.03 inches in 1932 and 17.91 inches in 1921, respectively. The mean relative humidity is 65 percent, and the average temperature is 65.8 degrees Fahrenheit (Reference 3).

2.3 Principal Flood Problems

Generally, the major floods experienced in the vicinity are produced by heavy rainfall from frontal type storms which occur in the spring and summer months. Major flooding can be produced by the intense rainfall usually associated with localized thunderstorms. These thunderstorms may occur at any time during the year but are more prevalent in the spring and summer months.

Large floods have been recorded on the West Fork Trinity River in May 1908, April 1922, June 1923, September 1932, June 1941, April 1942, May 1942, May 1949, and May 1957. The May 1908 flood produced a peak discharge of 184,000 cubic feet per second (cfs) in Dallas County. Based on present conditions, a flood of this magnitude would have a recurrence interval of approximately once in 500 years. Historical flood data were not available for Farmers Branch and Kings Branch.

Figure 2 shows potential flood heights on Farmers Branch.

2.4 Flood Protection Measures

There have been channel improvements and levees built on West Fork Trinity River and Farmers Branch. This study reflects these conditions. Nonstructural measures of flood protection in the form of land use regulations are being used to aid in the prevention of future flood damage.

FEMA specifies that all levees must have a minimum of three feet freeboard against 100-year flooding to be considered a safe flood protection structure. The levees built on West Fork Trinity River and Farmers Branch meet the FEMA freeboard requirement.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equaled or exceeded during

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Figure 2. Potential flood heights at Texas and Pacific Railroad over Farmers Branch.

any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for each flooding source studied in detail affecting the community.

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The computer program NUDALLAS was used in developing the hydrology for the streams studied by detailed methods (Reference 4). The watershed was divided into subareas, and synthetic unit and flood hydrographs were developed at selected locations. Weather Bureau Technical Paper No. 40 and National Oceanic and Atmospheric Administration Technical Memorandum NWS Hydro-35 were used in developing the 10-, 50-, and 100-year frequency storms (References 5 and 6). The 500-year storm was based on extrapolated data. Peak discharge-frequency values were computed for selected locations. Routing of the flood hydrographs through each sub-basin reach was accomplished using a modified Puls reservoir routing method. The HEC-2 backwater model provided the elevation-discharge-storage relationships for each reach on Farmers Branch and Kings Branch (Reference 7). A modified LRD-1 model provided the elevation-discharge-storage relationships on the West Fork Trinity River (Reference 8). The hydrologic analyses for the West Fork Trinity River were taken from the Flood Insurance Study for the unincorporated areas of Tarrant County (Reference 9).

A summary of the drainage area-peak discharge relationships for the streams studied by detailed methods is shown in Table 1, "Summary of Discharges."

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
WEST FORK TRINITY RIVER					
Below Lake Worth dam[1]	2,064	9,100	21,600	31,500	55,600
FARMERS BRANCH					
At confluence with West Fork Trinity River	11.4	11,200	14,400	15,900	20,350
Upstream confluence of Kings Branch	6.7	5,870	6,870	7,430	9,540
At Loop 341	5.1	5,010	6,450	7,100	8,540
KINGS BRANCH					
At confluence with Farmers Branch	4.5	5,300	6,460	7,030	8,270

[1]Outside corporate limits

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3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

Cross sections for the backwater analysis were field surveyed and were located at close intervals above or below bridges and culverts in order to compute the significant backwater effects of these structures.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross section locations are also shown on the Flood Boundary and Floodway Map (Exhibit 2).

Roughness factors (Manning's "n") used in the hydraulic computations were chosen by engineering judgment and based on field observations of the streams and flood plain areas. The following tabulation shows the channel and overbank "n" values for the streams studied by detailed methods.

Stream	Channel "n"	Overbank "n"
West Fork Trinity River	0.035-0.055	0.050-0.090
Farmers Branch	0.040-0.055	0.055-0.070
Kings Branch	0.045-0.060	0.065-0.075

Water-surface elevations of floods of the selected recurrence intervals for Farmers Branch and Kings Branch were computed using the COE HEC-2 step-backwater computer program (Reference 7). For the West Fork Trinity River, water-surface elevations were computed using the LRD-1 water-surface profiles computer program (Reference 8). Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals. Starting water-surface elevations for the streams studied by detailed methods were calculated using the slope/area method.

For the sump areas studied by approximate methods, storage capacity tables were developed from the City of Fort Worth topographic maps and project plans. Rough synthetic unit hydrographs were developed for most of the sumps using the existing conditions for percent urbanization. The volume produced from the inflow hydrograph was determined, and an elevation was estimated from the storage capacity tables.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in this study are shown on the maps.

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The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages State and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study produces maps designed to assist communities in developing flood plain management measures.

4.1 Flood Boundaries

To provide a national standard without regional discrimination, the 1 percent annual chance (100-year) flood has been adopted by FEMA as the base flood for flood plain management purposes. The 0.2 percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the 100- and 500-year flood plain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps (Reference 10). The 500-year flood boundary to the west of the West Fork Trinity River was delineated assuming the levee failed.

The sump areas studied by approximate methods were delineated using the topographic maps referenced above (Reference 10). For areas studied by approximate methods, only the 100-year flood plain boundary is shown.

The 100- and 500-year flood plain boundaries are shown on the Flood Boundary and Floodway Map (Exhibit 2). In cases where the 100- and 500-year flood plain boundaries are close together, only the 100-year flood plain boundary has been shown. Small areas within the flood plain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

4.2 Floodways

Encroachment on flood plains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood plain is

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divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent flood plain areas, that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodways presented in this study were computed on the basis of equal conveyance reduction from each side of the flood plain. The results of these computations are tabulated at selected cross sections for each stream segment for which a floodway is computed (Table 2).

As shown on the Flood Boundary and Floodway Map (Exhibit 2), the floodway boundaries were computed at cross sections. Between cross sections, the boundaries were interpolated. In cases where the floodway and 100-year flood plain boundaries are either close together or collinear, only the floodway boundary has been shown.

The floodway for the West Fork Trinity River is shown on the landward edge of the levee on the west bank to protect the structural integrity of the levee. The floodway for the initial 2,000 feet of Farmers Branch is shown coincident with the landward edge of the West Fork Trinity River levee and the Tarrant County Water Control and Improvement District No. 1 Easement.

The area between the floodway and 100-year flood plain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 3.

5.0 INSURANCE APPLICATION

To establish actuarial insurance rates, data from the engineering study must be transformed into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors, and flood insurance zone designations for each flooding source studied in detail in the City of Westworth Village.

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Kings Branch								
A	645	100	727	9.7	568.1	568.1	568.1	0.0
B	2,055	150	1,235	5.7	575.8	575.8	576.5	0.7
C	3,190	300	1,938	3.6	586.0	586.0	587.0	1.0

[1]Feet above confluence with Farmers Branch

TABLE 2

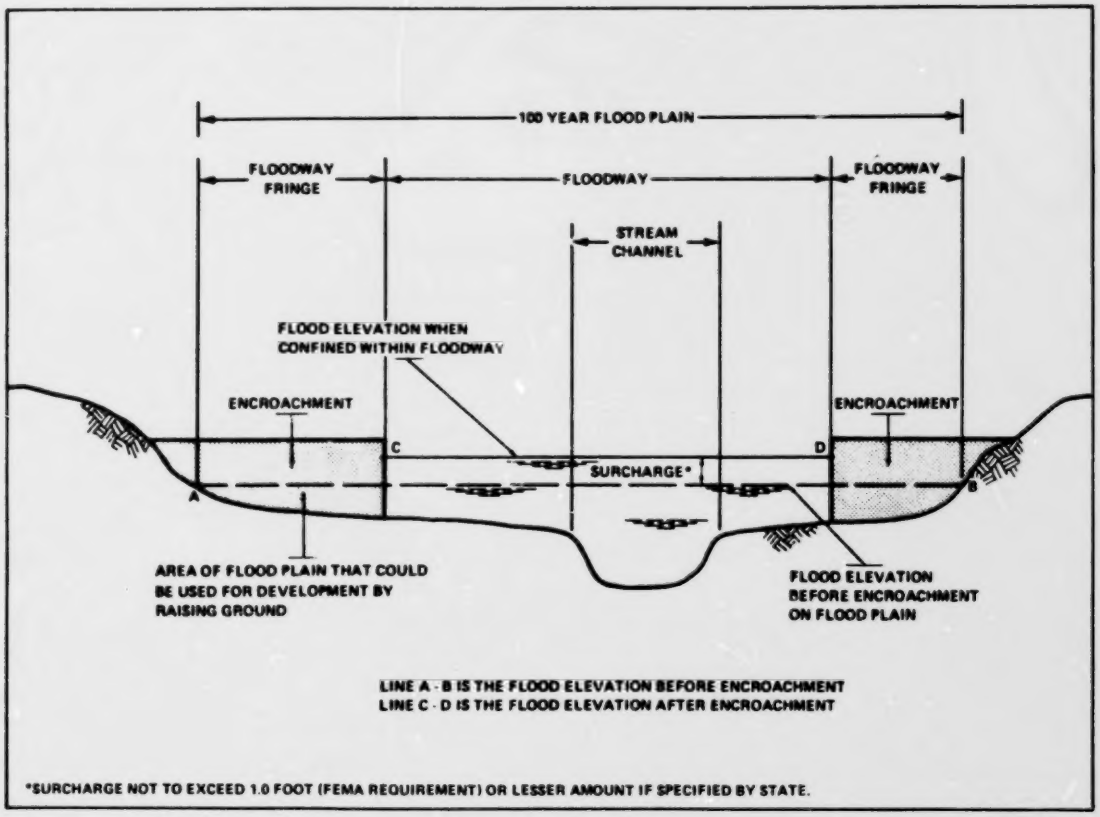
FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF WESTWORTH VILLAGE, TX

(TARRANT CO.)

FLOODWAY DATA

KINGS BRANCH


100 YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE A - B IS THE FLOOD ELEVATION BEFORE ENCROACHMENT
LINE C - D IS THE FLOOD ELEVATION AFTER ENCROACHMENT
*SURCHARGE NOT TO EXCEED 1.0 FOOT (FEMA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE.

FLOODWAY SCHEMATIC Figure 3

5.1 Reach Determinations

Reaches are defined as sections of flood plain that have relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference may not have a variation greater than that indicated in the following tabulation for more than 20 percent of the reach:

Average Difference Between 10- and 100-Year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot
7.1 to 12 feet	2.0 feet
More than 12 feet	3.0 feet

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The locations of the reaches determined for the flooding sources of the City of Westworth Village are shown on the Flood Profiles (Exhibit 1) and summarized in Table 3.

5.2 Flood Hazard Factors

The Flood Hazard Factor (FHF) is used to establish relationships between depth and frequency of flooding in any reach. This relationship is then used with depth-damage relationships for various classes of structures to establish actuarial insurance rate tables.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations rounded to the nearest one-half foot, multiplied by 10, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year flood water-surface elevations is greater than 10.0 feet, it is rounded to the nearest whole foot.

5.3 Flood Insurance Zones

Flood insurance zones and zone numbers are assigned based on the type of flood hazard and the FHF, respectively. A unique zone number is associated with each possible FHF, and varies from 1 for a FHF of 005 to a maximum of 30 for a FHF of 200 or greater.

Zone A:	Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods; no base flood elevations shown or FHFs determined.
Zones A2, A21, and A23:	Special Flood Hazard Areas inundated by the 100-year flood; with base flood elevations shown, and zones subdivided according to FHFs.
Zone B:	Areas between the Special Flood Hazard Areas and the limits of the 500-year flood; areas that are protected from the 100- or 500-year floods by dike, levee, or other water control structure; areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.
Zone C:	Areas of minimal flooding; not subdivided.

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FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FHF	ZONE	BASE FLOOD ELEVATION[3] (NGVD)
		10% (10 YR.)	2% (50 YR.)	0.2% (500 YR.)			
West Fork Trinity River							
Reach 1	01	-11.0	-3.6	+6.6	110	A21	Varies
Reach 2	01	-13.0	-4.2	+6.8	130	A23	Varies
Farmers Branch							
Reach 1	01	-1.0	-0.3	+0.9	010	A2	Varies
Kings Branch							
Reach 1	01	-1.0	-0.3	+0.3	010	A2	Varies

[1]Flood Insurance Rate Map Panel
[2]Weighted Average
[3]Rounded to the nearest foot - see map

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF WESTWORTH VILLAGE, TX

(TARRANT CO.)

FLOOD INSURANCE ZONE DATA

WEST FORK TRINITY RIVER - FARMERS BRANCH - KINGS BRANCH

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Flood elevation differences, FHFs, flood insurance zones, and base flood elevations for the flooding sources studied in detail in the community are shown in Table 3.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the City of Westworth Village is, for insurance purposes, the principal result of the Flood Insurance Study. This map contains the official delineation of flood insurance zones and base flood elevations. Base flood elevation lines show the locations of the expected whole-foot water-surface elevation of the base (100-year) flood. The base flood elevations and zone numbers are used by insurance agents, in conjunction with structure elevations and characteristics, to assign actuarial insurance rates to structures and contents insured under the National Flood Insurance Program.

6.0 OTHER STUDIES

Flood Insurance Studies are currently being prepared for the Cities of Fort Worth and White Settlement (References 11 and 12). The results of those studies will be in complete agreement with the results of this study.

Due to the more detailed analyses, this Flood Insurance Study supersedes the previous Flood Hazard Boundary Map for the City of Westworth Village (Reference 13).

7.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, Federal Emergency Management Agency, Regional Director, Region VI Office, Federal Center, Denton, Texas 76201.

8.0 BIBLIOGRAPHY AND REFERENCES

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12. Federal Emergency Management Agency, Flood Insurance Study, City of White Settlement, Tarrant County, Texas (Unpublished).

13. U. S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Hazard Boundary Map, City of Westworth Village, Tarrant County, Texas, June 25, 1976.

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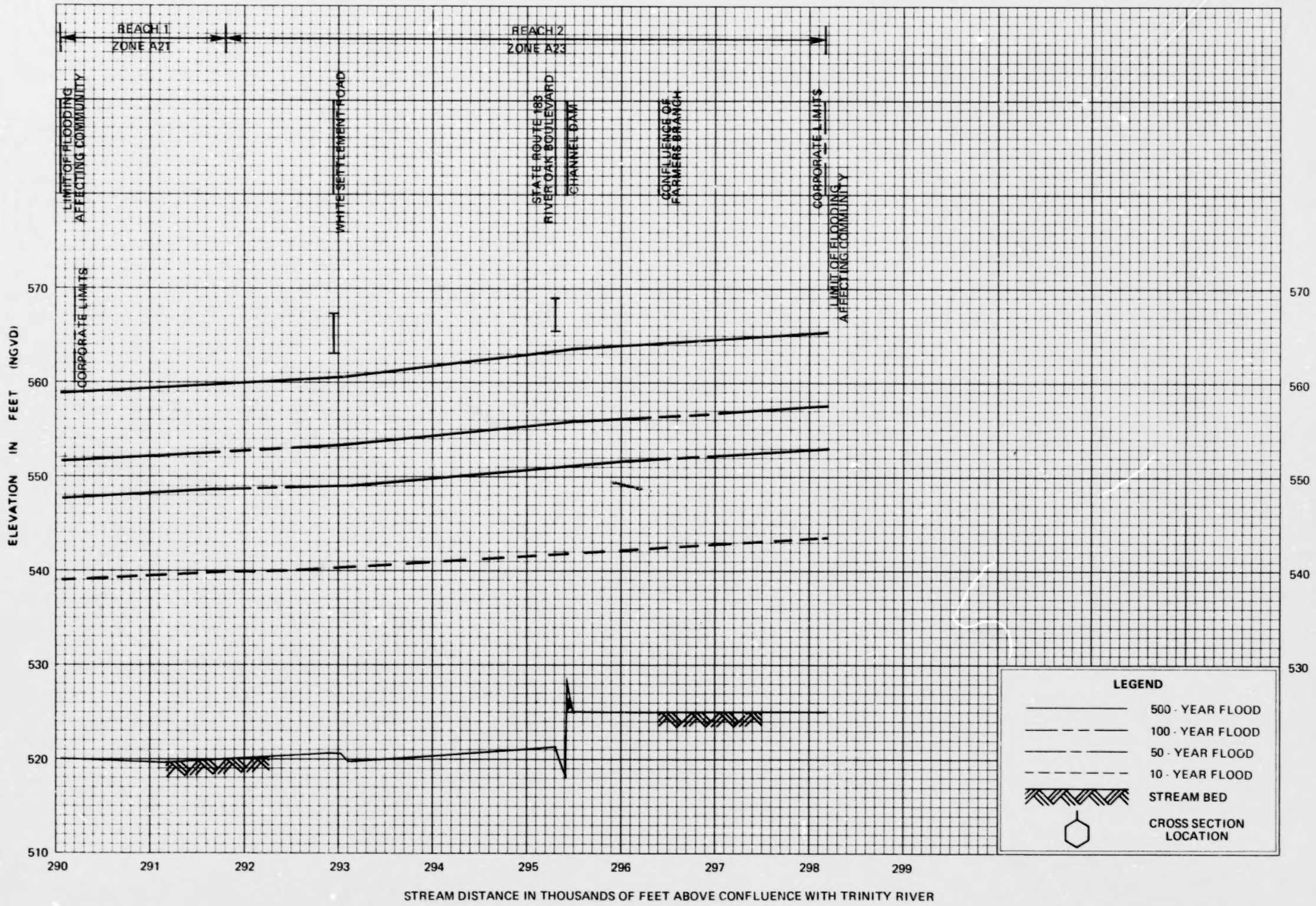

FLOOD PROFILES

WEST FORK OF THE TRINITY RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF WESTWORTH VILLAGE, TX
(TARRANT CO.)

01P

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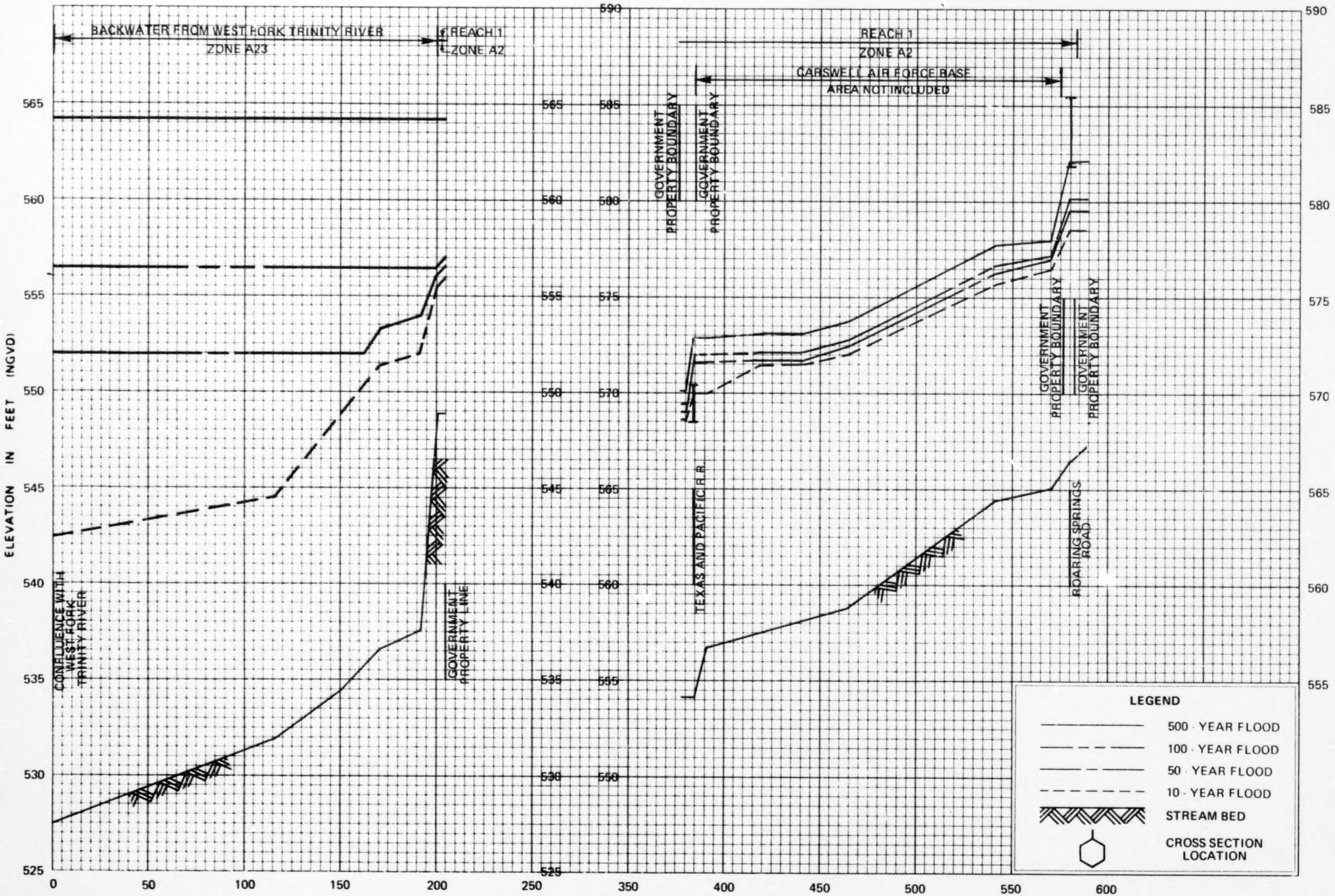

FLOOD PROFILES

FARMERS BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF WESTWORTH VILLAGE, TX

(TARRANT CO.)

02P

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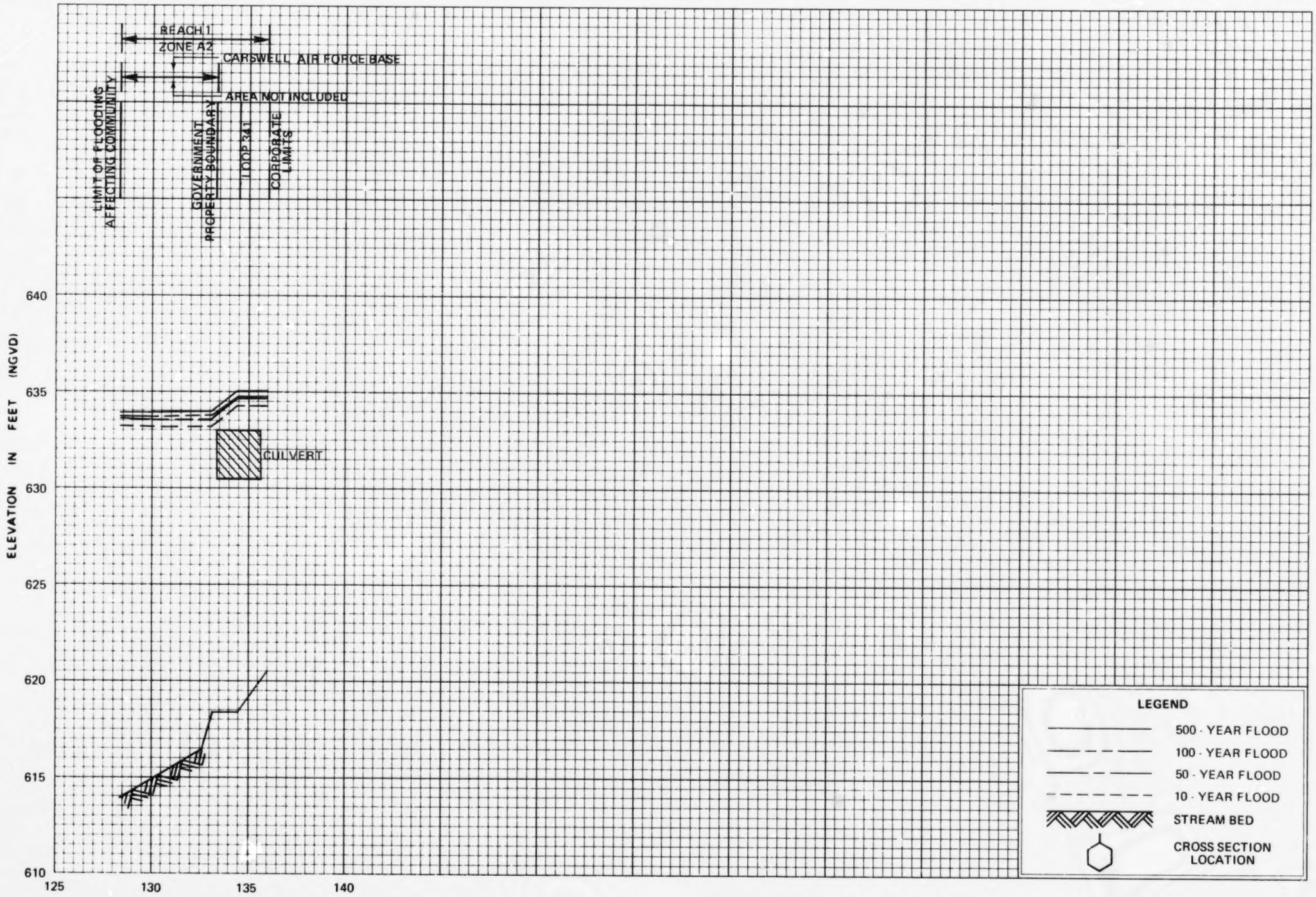

FLOOD PROFILES

FARMERS BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF WESTWORTH VILLAGE, TX
(TARRANT CO.)

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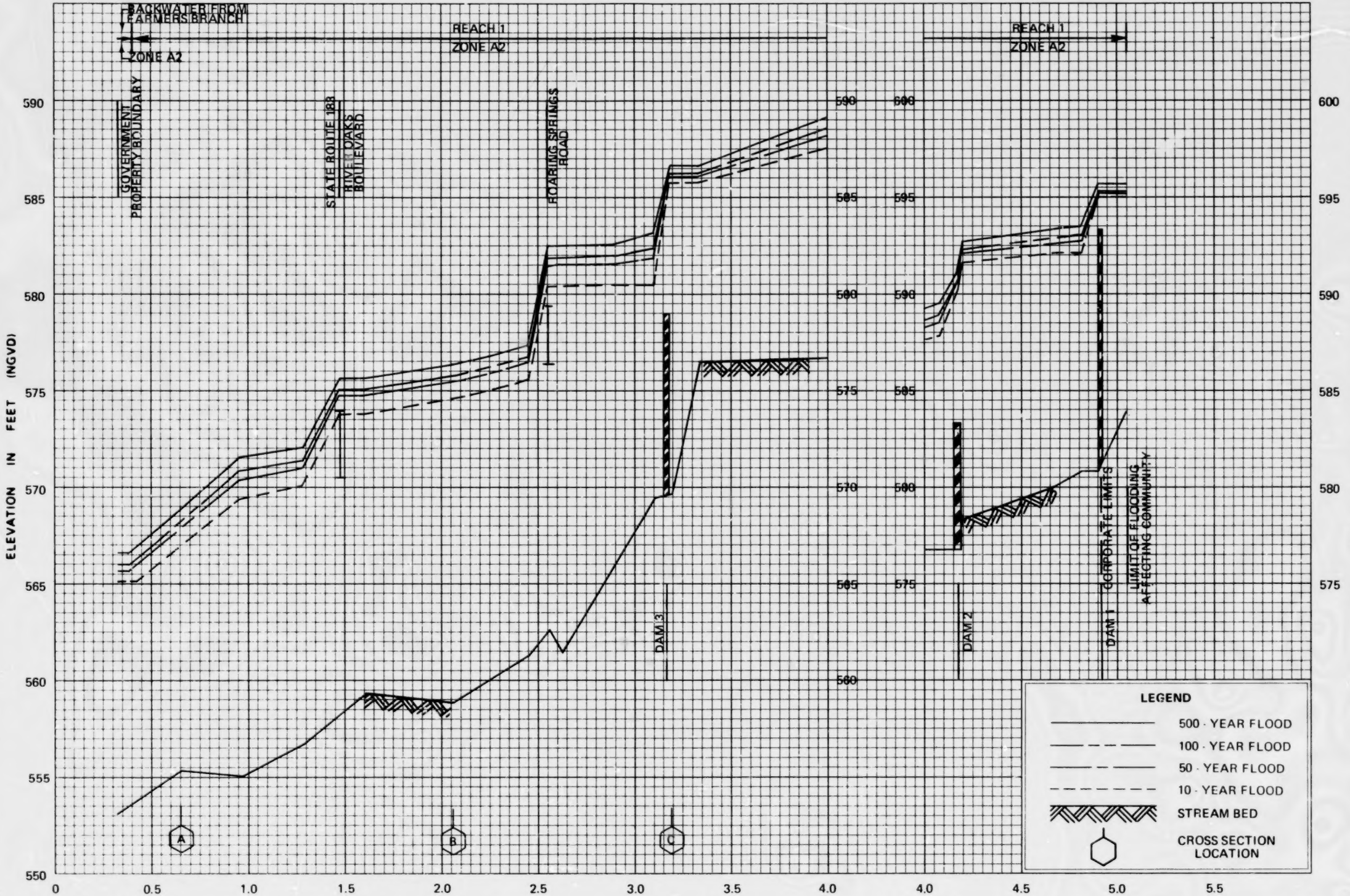

FLOOD PROFILES

KINGS BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF WESTWORTH VILLAGE, TX

(TARRANT CO.)

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